

Application No. 10/654378
Reply to Office Action July 26, 2005

135371-1

Listing of the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1. (Original) A transparent underfill composition comprising a curable resin in combination with a solvent and a filler of colloidal silica that is functionalized with at least one organoalkoxysilane.

Claim 2. (Original) A composition as in claim 1, wherein the resin is selected from the group consisting of epoxy resins, acrylate resins, polyimide resins, fluorocarbon resins, fluororesins, benzocyclobutene resins, bismaleimide triazine resins, fluorinated polyallyl ethers, polyamide resins, polyimidoamide resins, phenol resol resins, aromatic polyester resins, polyphenylene ether resins and polydimethyl siloxane resins.

Claim 3. (Original) A composition as in claim 1, wherein the resin is selected from the group consisting of aliphatic epoxy resins, cycloaliphatic epoxy resins, and silicone-epoxy resins.

Claim 4. (Original) A composition as in claim 1, wherein the resin is an aromatic epoxy resin.

Claim 5. (Original) A composition as in claim 4, wherein the aromatic epoxy is a cresol-novolac epoxy.

Claim 6. (Original) A composition as in claim 1, wherein the composition further comprises a resin hardener.

Claim 7. (Original) A composition as in claim 1, wherein the solvent is selected from the group consisting of 1-methoxy-2-propanol, butyl acetate, methoxyethyl

Application No. 10/654378
Reply to Office Action July 26, 2005

135371-1

ether, methoxy propanol acetate and methanol.

Claim 8. (Original) A composition as in claim 1, wherein the colloidal silica is functionalized with phenyl trimethoxysilane.

Claim 9. (Original) A composition as in claim 8, wherein the colloidal silica is endcapped by a silylating agent.

Claim 10. (Original) A composition as in claim 9, wherein the silylating agent is hexamethyldisilazane.

Claim 11. (Original) A composition as in claim 1, wherein the filler of colloidal silica further comprises silicon dioxide in an amount ranging from about 15 wt.% to about 75 wt.% of the composition.

Claim 12. (Original) A composition as in claim 11, wherein the colloidal silica has a particle size ranging from about 5 nm to about 100 nm.

Claim 13. (Original) A composition as in claim 12, wherein the colloidal silica is uniformly distributed throughout the resin.

Claim 14. (Original) A composition as in claim 13, wherein the colloidal silica is stable at room temperature.

Claim 15. (Original) A composition as in claim 1, wherein the composition further comprises a catalyst selected from the group consisting of triphenyl phosphine, N-methylimidazole, and butyl tin dilaurate.

Claim 16. (Original) A composition as in claim 1, wherein the composition further comprises additives selected from the group consisting of flame retardants, adhesion promoters, reactive organic diluents, curing agents, and combinations thereof.

Claim 17. (Original) A composition as in claim 16, wherein the reactive organic diluent comprises a monofunctional epoxy.

Application No. 10/654378
Reply to Office Action July 26, 2005

135371-1

Claim 18. (Original) A transparent underfill composition comprising an epoxy resin in combination with a solvent and a functionalized colloidal silica dispersion wherein the functionalized colloidal silica further comprises silicon dioxide in the range of about 15 wt.% to about 75 wt.% of the functionalized colloidal silica dispersion.

Claim 19. (Original) A composition as in claim 18, wherein the epoxy resin is cresol novolac epoxy resin.

Claim 20. (Original) A composition as in claim 19, wherein the composition further comprises a novolac hardener.

Claim 21. (Original) A composition as in claim 18, wherein the solvent is 1-methoxy-2-propanol.

Claim 22. (Original) A composition as in claim 18, wherein the functionalized colloidal silica has a particle size ranging from about 5 nm to about 50 nm.

Claim 23. (Original) A composition as in claim 18, wherein the composition further comprises a catalyst selected from the group consisting of triphenyl phosphine, N-methylimidazole, and butyl tin dilaurate.

Claim 24. (Original) A solid state device comprising:

a chip;

a substrate; and

a transparent underfill composition between the chip and the substrate comprising an aromatic epoxy resin in combination with a solvent and a functionalized colloidal silica dispersion wherein the functionalized colloidal silica is functionalized with at least one organoalkoxysilane.

Claim 25. (Original) A solid state device as in claim 24, wherein the functionalized colloidal silica has a particle size ranging from about 5 nm to about 50 nm.

Application No. 10/654378
Reply to Office Action July 26, 2005

135371-1

Claim 26. (Original) A solid state device as in claim 24, wherein the solvent is selected from the group consisting of 1-methoxy-2-propanol, butyl acetate, methoxyethyl ether, methoxy propanol acetate and methanol.

Claim 27. (Original) A solid state device as in claim 24, wherein the resin wafer coating further comprises additives selected from the group consisting of resin hardeners, resin catalysts, flame retardants, adhesion promoters, reactive organic diluents, curing agents, and combinations thereof.

Claim 28. (Original) A transparent composition of matter for use in forming an underfill comprising a curable resin in combination with a solvent and a filler of colloidal silica that is functionalized with at least one organoalkoxysilane.

Claim 29. (Original) A composition as in claim 28, wherein the resin is selected from the group consisting of aliphatic epoxy resins, cycloaliphatic epoxy resins, and silicone- epoxy resins.

Claim 30. (Original) A composition as in claim 28, wherein the resin is an aromatic epoxy resin.

Claim 31. (Original) A composition as in claim 28, wherein the solvent is selected from the group consisting of 1-methoxy-2-propanol, butyl acetate, methoxyethyl ether, methoxy propanol acetate and methanol.

Claim 32. (Original) A composition as in claim 28, wherein the colloidal silica is functionalized with phenyl trimethoxysilane.

Claim 33. (Original) A composition as in claim 32, wherein the colloidal silica is endcapped by a silylating agent.

Claim 34. (Original) A composition as in claim 33, wherein the silylating agent is hexamethyldisilazane.

Application No. 10/654378
Reply to Office Action July 26, 2005

135371-1

Claim 35. (Original) A composition as in claim 28, where the composition is a transparent B-stage resin.

Claim 36. (Original) A method for producing a transparent underfill composition comprising:

functionalizing colloidal silica such that a stable concentrated dispersion of colloidal silica is formed;

forming a concentrated dispersion of functionalized colloidal silica containing about 15 wt.% to about 75 wt.% silica;

blending solutions of epoxy monomers with the functionalized colloidal silica dispersion;

removing the solvent to form a hard, transparent B-stage resin film; and

curing the transparent B-stage resin film to form a low CTE, high Tg thermoset resin.

Claim 37. (Original) The method of claim 36 wherein the step of functionalizing colloidal silica comprises functionalizing colloidal silica with phenyl trimethoxysilane.

Claim 38. (Original) The method of claim 36 wherein the step of forming a concentrated dispersion of functionalized colloidal silica comprises placing the functionalized colloidal silica at a temperature ranging from about 20°C. to about 140°C. under a vacuum ranging from about 0.5 Torr to about 250 Torr.

Claim 39. (Original) The method of claim 36 wherein the step of blending solutions of epoxy monomers with the functionalized colloidal dispersion further comprises adding to the solution of epoxy monomer an additive selected from the group consisting of selected from the group consisting of flame retardants, adhesion promoters,

Application No. 10/654378
Reply to Office Action July 26, 2005

135371-1

reactive organic diluents, curing agents, and combinations thereof.

Claim 40. (Original) The method of claim 36 wherein the step of blending solutions of epoxy monomers with functionalized colloidal silica comprises placing the epoxy monomers in a solvent selected from the group consisting of 1-methoxy-2-propanol, butyl acetate, methoxyethyl ether, methoxy propanol acetate and methanol.

Claim 41. (Original) The method of claim 36 wherein the step of curing the transparent B-stage resin film comprises placing the B-stage resin film at a temperature ranging from about 50°C to about 250°C in a vacuum at a pressure ranging from about 75 mmHg to about 250mmHg.

Claim 42. (Original) A transparent B-stage resin film made by the process of claim 36.

Claim 43. (Original) A low CTE, high Tg thermoset resin made by the process of claim 36.